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Peter Chinloy

University of British Columbia

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CONTENTS

This report has the objective of measuring the contribution of education and other characteristics of employment to the growth of productivity in Canada. For policy purposes on skill development leave, it is important to determine the productivity gain by workers for different age groups. The purpose is first to examine the costs and benefits of educational leave, whether paid or unpaid. Estimates of the productivity gains from training for Canada are then reviewed.

For the study, a detailed examination is performed of educational effects on productivity growth in Canada using Census dat for 1971 and 1976. From these data, policy implications for educational leave are drawn.

The study examines a cross classification of employment by region, age, sex and education in Canada between 1971 and 1976. Each of these categories of employment is further decomposed into levels. In education, there are six categories, namely no schooling, some grade school, some high school, completed high school, some university and university degree completed and above.

The contribution of each of these six educational categories to the growth of labour input in Canada is examined. It is found that there are negligible effects for all groups below post secondary levels. For skill development, this suggests that there are small productivity benefits from retraining of workers without at least high school completed.

Regarding age, young workers on average have a negative effect on productivity growth. Hence the loss from removal of these workers through skill development leave is small. The lost productivity increases with age. Thus it is more advantageous to train younger workers. These conclusions support a focus on younger worker acquisition of advanced education.

There are no substantial regional effects. A skill development program can apply uniformly across the country. By sex, there are substantial differences, but policy implications are confounded by the difficulty of distinguishing the portion of observed male-female wage differentials attributable to discrimination.

While on a strict productivity basis the emphasis appears to be on younger and relatively more educated workers, there may be other reasons to introduce skill development leave for other workers. Reasons include the benefit socially of a literate and articulate work force, and the ability of workers to be flexible in the face of technological change.

1. Introduction

There has been increasing concern regarding the contribution of education to economic growth and productivity. Evidence from estimation of rates of return to educational investment, either private or social, suggests that the era of underinvestment in college training and higher education is at an end. In 1960 the issue was whether there was underinvestment, and the concern by the 1980's is whether there has been overinvestment.

Even if it is determined that the return to educational investment has declined, this does not necessarily imply a reduction of its contribution to growth and productivity. The reason is that over time, the proportion of educated workers is increasing. If more educated workers are paid higher wages than less educated workers, the increase in the absolute numbers, and the increasing average educational attainment may both be contributors to productivity growth.

This report presents evidence on the contribution of educational attainment to labour input and productivity growth in Canada during the period since 1971. From these estimates, various policy implications can be drawn.

The purpose of this examination is to focus policy on the provision of paid or unpaid educational leave. There are two main issues in the examination of such a policy. The first is the contribution to labour input and productivity growth of educated workers by age. If the educational contribution of one more year in higher schooling decreases with age, then the model is less favourable to paid educational leave. That this effect is likely arises because older workers have a shorter time to recoup their

investments, and the current opportunity cost of resources foregone is higher. The second issue is the extension of such policies to cover workers whose propensity to enroll in educational development is low. Information on occupational requirements for education, and the contribution to labour input growth of each level of education is relevant here.

This report is structured as follows. In section 2, programs and issues related to paid or unpaid educational leave are examined, to place the results in an institutional context. The potential benefits and costs of such a policy are discussed. There are various issues in implementation. These include the danger that unemployed workers may be artificially redefined into training to reduce measured unemployment, that only relatively able or younger workers will take the training, and that the tendency will be for specific vocational training to be taken. In section 3 evidence on the contribution of education to productivity growth in Canada is summarized. Section 4 presents the model of labour input aggregation, and the procedure by which the contribution of education to productivity growth may be measured, when it is possible to distinguish between other components of labour input such as age and occupation. As discussed above, it is critical in examining paid educational leave provisions to determine the interaction of education with other characteristics of employment which contribute to labour input.

Section 5 reports on data and empirical results for Canada on the contribution of education. Data are taken from the 1971

and 1976 Censuses of Canada. Employment is distinguished by educational attainment, age, sex and region. The contribution of each of these factors to productivity growth is detailed. In section 6, the implications for educational leave policy are indicated. Section 7 details some potential policy issues to be accounted for, notably that this analysis includes only market time, and education may enhance the productivity of time spent outside of work. Section 8 details some implementation issues.

The principal conclusion is that the productivity returns from education arise more largely in higher education than in the lower education groups. Hence the return to basic skill training is likely to be lower. Second, the contribution from upgrading younger workers is larger. Policies on educational leave, if directed only at the issue of productivity in the labour market, should be directed to upgrading younger workers who have at least high school completed.

2. Educational Leave: Policies and Background

The institution of educational leave, either paid or unpaid, has been established in Western Europe, but this has been less the case in North America. In Western Europe, there is legislation in France, West Germany, Britain and Sweden, among others, providing for educational leave. In the United States, lifelong learning has become an attached rider to allocations for educational expenditures. The conventional definition of educational leave is as provided by the International Labour Organization in 1974:

"....leave granted to a worker for educational purposes

for a specified period during normal working hours with adequate financial entitlements."

A definition such as this introduces as many questions as it answers. First, there is the issue of the type of educational leave. There is a difference between general and specific training. The former is applicable in many work situations, and hence provides no direct benefit to the employer. The latter applies to the particular work situation. Second, there is the question of the degree and extent of compensation to be paid for such educational leave.

In discussing the issues of educational leave, first the benefits and costs of such a policy are examined. Subsequently, specific problems in the implementation of such a policy in the labour market are analyzed.

Consider the benefit side. First, in an environment of uncertain but positive technological change, there are possible social returns to providing flexibility to workers. Such flexibility implies that movement between jobs is more fluid, with shorter durations of unemployment. As such, it is part of the regular labour market support provided to an individual by society, analogous to unemployment insurance. In fact, the greater flexibility may economize on payments between jobs.

The second benefit from such educational leave also lies in the social domain. If there are general skills such as basic literacy lacking in older workers, there may be a gain in providing the flexibility to acquire them at any age. Related to this is the issue of technical change and obsolescence of skills. At a young age, the future course of occupational demand cannot

be easily predicted for a forty year potential period in the work force. In such circumstances, there may be a requirement for continual retraining through a work career. Estimates of the private and social rates of return to basic literacy are large.[1] These returns are usually computed for young people, where the opportunity cost in lost output is lower, and the cost of training teachers and other personnel is low relative to the case at higher levels of education. The relevant consideration here is whether the same returns obtain for older workers. The opportunity cost in foregone output is higher, and the costs of education may also be higher for adults.

The third type of benefit, that focused upon in this research, is the resultant increase in productivity as a consequence of educational leave. In terms of reporting, the issues are possible gains at the aggregate level in the quality of labour input, and the increase in output per unit of input. However, at the disaggregate level, there also appears to be a gain in productivity from the introduction of educational leave. At the plant level, an analysis of the Smederevo Metalworks in Yugoslavia indicates that output per worker, tool breakage, product quality, injury rates and self-reliance rates all improved after the institution of such policies. Productivity, defined as output per worker, increases by between 9.8 and 24 per cent after training, and the costs of the leave are recouped in 9-18 months.[2] This suggests that there are positive returns to training.

A fourth area of benefit centres on the conventional arguments in favour of education. A more educated population is

more articulate, more willing to make careful and considered social choices, and less prone to crime or mental illness. There is a general effect on literacy and numeracy. This benefit underlies official policy in Sweden.

It remains to examine the costs of providing such educational leave. The first, and most important is whether the leave is paid or unpaid. The ILO definition of adequate financial compensation does not clarify the issue. If workers are to be provided with full salary by employers, the requirement by firms will be for specific skills, which yield return largely to the firm. The evidence from the Western European experience is that educational leave is essentially granted for short durations, and for specific training.[3] The payment of full salary for training increases with age, so the cost is increasing with age. Again, the evidence from European countries is that younger workers are those that tend to take advantage of educational leave.

A second component of costs is related to the required overhead of trained teachers and facilities. Since these are frequently in existing educational institutions, the marginal cost may be lower than for regular education. With growing excess capacity in the educational sector, the costs of a direct nature may not be substantial.

A third issue is the substitutability for trainees by those temporarily replacing them. The estimation of such elasticities indicates the cost to a firm in lost output in the short run of having a temporary replacement trained for a short duration.

Ultimately, the success of such a program depends on

weighing the enumerated costs and benefits of educational leave. There are also a number of policy issues surrounding the introduction of such a program. Included among these are:

i. Redefining unemployment. There is the impression that many of the programs of paid educational leave, particularly in Western Europe, serve partially to redefine persons from unemployment to the educational sector, where they are counted as not in the labour force. As a result, the measured unemployment rate can be reduced. In Sweden, for example, the measured unemployment rate is artificially reduced from the assignment to education. To qualify for state supported educational leave, individuals must be unemployed or in danger of being so. If this is the case, they are eligible for retraining in occupations where demand exists.[4] The minimum age is generally 20 years, but under certain circumstances, those aged 18 or 19 are eligible. Allowances are provided by the government for basic support, rent and a per diem payment. However, this program should be viewed as complementary to labour market support programs such as unemployment insurance, and care is needed to define participants as unemployed.

ii. Self-selection. Even in programs providing for continuing labour market education, there is likely to be some self-selection. The potential participants are the relatively more able or motivated. On any given sample of participants, it is not possible to extrapolate to the remaining people. Related to this is the tendency for younger workers to be participants, and for older workers to shun such programs. The theory of optimal human capital accumulation argues that schooling should

occur when young, and it appears that educational leave programs are taken up largely by younger workers.

iii. Specific and general skills. The observed European experience is that specific skills are learned during an educational leave period. If society gains from a more literate and numerate work force, there is likely to be an emphasis on general skill acquisition. However, this requires paid educational leave, with the government providing the payment as in Sweden. Given the rising cost with age, this may incur financial problems.

iv. On or off job training. If the training can be provided at the work site, there are lower costs of commuting, and the worker may be able to work part time during the training. The Japanese experience with quality circles indicates that there is a gain to informal or formal discussion of problems at the workplace.

Ultimately there is the issue of the cost of these programs. In the Report of the Commission of Inquiry on Educational Leave and Productivity headed by R.J. Adams (1979), the principal recommendation is for a training levy on firms.[5] This raises as many questions as it solves. If educational leave is to be financed by a training levy on firms, the emphasis will have to be on specific rather on general skills. Further, the increased cost of hiring initially inflexible workers, those with less formal schooling, will induce greater substitution of other factors, notably capital and skilled labour. The evidence is that substitution elasticities of both skilled labour and capital

for less skilled labour are high. On scale of operation, the imposition of a training levy would reduce profits and output. Regarding the demand for labour generally, it would decline, depending on the relevant elasticity used. If the aggregate production function between capital and labour follows a Cobb-Douglas technology with an elasticity of substitution between capital and labour of unity, and labour receives 75% of value added as compensation, the elasticity of demand for labour is -0.75. A 1% increase in labour costs to finance the training would reduce labour demand in the short run by 0.75 of 1%, although ultimately there would be a return to the training received.

The emphasis of this report is on the productivity effect of paid or unpaid educational leave. In the Canadian context, the results focus on the returns to formal education. It is more difficult to measure the effects of on the job training, but this is not of relevance here as educational leave would probably entail a leave from the work site.

3. Education's Contribution to Productivity Growth in Canada

The pioneering estimates for labour quality change in Canada are performed by Walters (1968) at the Economic Council of Canada. Using data from the Census of Canada, adjustments for changes in the composition of labour by age and sex are carried out. The quantities of labour are not separately distinguished between hours worked versus total persons employed, and paucity of relative earnings data for Canada requires the use of comparative information for the United States. Nevertheless, Walters is able to construct an estimate of the age-sex

contribution to measured labour input, as a first step in measuring the contribution of education by age group. The age-sex index takes on the following values, normalizing on 1950=100 :

1950	100.0	1955	99.9
1960	98.7	1962	98.3

indicating that the combined influences of age and sex contribute negatively to labour quality.[7]

The quality analysis is extended to education. For education only, again normalized in 1950, the index levels are:

1950	100.0	1955	102.0
1960	103.8	1962	104.3

for an average contribution of education to labour input of 0.35 per cent annually.[8] The next procedure is to measure the contributions of age, sex and education. This is performed by multiplying the indices together as in Denison (1974,1979), and a negative growth rate for labour quality is obtained.

The results would indicate the contribution of education to labour input and ultimately productivity growth by age, but there is no cross-classification of education and age. These two characteristics are assumed to be independent. The contribution of education does not depend on age. This must be made a testable hypothesis, particularly if paid or unpaid educational leave policies are to be evaluated. Considering the educational contribution alone, the estimates are half those obtained for the United States in a comparable period.

The estimates of the contribution of education to the growth in labour input have been updated by Christensen, Cummings and Jorgenson (1980) for Canada. Data for the 1961 and 1971 Censuses

of Canada are used, and interpolated for years in between. The index of educational attainemnt has levels of 0.923 in 1947, 1.000 in 1961, the base year, and 1.059 in 1973. For 1950-1962 they obtain an annual growth rate of 0.47 per cent, higher than Walters, and 0.42 per cent for the entire period.[9]

Since there are no data on the age structure of educational attainment and the occupational composition is not included, it is difficult to extrapolate to policies on educational leave. Another issue is the possibility of a decline in the contribution of education to the growth in labour input and quality. The period since the 1971 Census has witnessed an increase in the relative quantity of educated workers. Further, there is evidence, at least from Labour Force Survey data, that the relative wage of the educated is declining. This is not accounted for in the Christensen, Cummings and Jorgenson estimates, for they use the 1971 Census earnings relatives, and assume that these are constant over time.

Previous estimates of the contribution of education to labour quality growth indicate, nevertheless, that the effect of education on labour input is to increase it by anywhere from one third to one half of one per cent per annum. Once this estimate is known, the contribution to aggregate productivity can be determined. The derivation of this is performed subsequently.

It remains to report on the estimates of the contribution to labour input of any other characteristics of employment relevant to educational leave policy. A specific case in point is occupation. Estimates of labour quality change by occupation and

sex have been constructed by May and Denny (1978) for aggregate manufacturing in Canada. Wages of men and women are assumed to reflect the marginal productivity in each case. If discrimination or other factors independent of productivity lead to wage differentials by sex, the results on labour quality are biased. Since on average women are paid less than men, if female employment is increasing more rapidly than male employment, more weight is placed on lower "quality" workers. If wages contain discriminatory differentials, the resulting labour quality index is biased downwards.

The results obtained by May and Denny for labour quality indicate that total factor productivity growth is relatively unaffected by disaggregating labour into occupation and sex categories. This measure of output per unit of aggregate inputs, with 1961 being normalized at unity, is 0.893 in 1949 and 1.098 in 1969, for a 1.03 per cent average annual increase over the period. This is for the case where labour is defined as total hours worked. When labour is defined as total hours worked multiplied by a labour quality index reflecting the services of occupation and sex, the results are similar. Occupational shifts in composition have the following effects on labour input growth for Canadian manufacturing:

1949-1953	0.01	1953-1958	0.03
1958-1964	0.08	1964-1969	-0.06

with slightly lower estimates for the occupation and sex index. The conclusion is that occupational shifts have been small. In turn, training and leave provisions to permit occupational shifts may have a small effect of labour input growth and productivity.

This review of previous estimates of the contribution of charateristics relevant for paid educational leave to labour input and productivity growth may be summarized. Over the period up to the 1970's in Canada, there has been a positive contribution of education to labour input growth, although the estimates obtained are lower than for the United States. Since the 1970's and 1980's have been periods where there are indications of declining relative earnings of the educated, these estimates must be updated. Any policies on educational leave must include the most recent available information on the contribution of education to productivity growth. Using data from the period up to the 1971 Census will overstate the case in favour of educational returns. Further, the contribution of education by age and occupation is important in determining the potential success of such policies.

The next objective is to examine the contribution of education to labour input and productivity growth. From this structure, which includes alternative characteristics such as age and occupation, it is possible to compute the return to educational investment in terms of productivity growth.

4. Labour Input, Labour Quality and Productivity Growth

Labour input, in the aggregate production function, is composed of the services of various types of workers. If x is an index of the labour input in the production function, then

$$(1) \qquad x = hf(h_1/h,\ldots,h_N/h) = he(h_1,\ldots,h_N)$$

where $h_1,\ldots,h_N$, denotes the hours worked by each of N types of

workers. The N types of workers are distinguished by characteristics such as age, sex, education and occupation. The classification is mutually exclusive and exhaustive, so that each i=1,....,N describes one type. For example, one group may be 25-34 year old males with high school completed and be craftsmen, if the occupational code is on a one digit basis. For policy on paid or unpaid educational leave, the interaction between the other characteristics and education may be important. If there are no interactions, and the contribution of education is independent of age, sex or occupation, there can be constructed an index depending only on hours classified by education.

In (1), total hours worked are h, or 1*h, where 1 denotes the unit vector, and h is the vector of hours worked. The second equation in (1) states that total labour input may be expressed as a product of total hours worked, h, and an index of the services or quality provided per hour $e(h_1,....,h_N)$. The latter index e reflects the effect of education and the other classifying factors. If all hours worked produce the same services, or are identical, then $e=1$ and changing education is irrelevant. To construct the total labour input used, one need only sum up total hours worked in h. In this case, education, regardless of the time of life acquired, has no effect on labour input, and consequently no effect on productivity.

The effect of education and future training or educational leave can be examined as to its effect on total employment, or persons at work and average hours worked per person. Total hours worked in each category are the product of total employment and average hours worked. Hence (1) can be further decomposed into

the product of four components, namely total employemnt, average hours worked for all workers, labour quality per employed person and labour quality per hour. Education would enter the construction of the last two indices. Finally, labour quality per hour and per employed worker can be decomposed into effects corresponding to those of each factor, along the lines of the analysis of variance.[10]

The decomposition into employment and hours effects commences from the fact that if data on employed workers only are used, with no regard to hours worked, analogously to (1)

$$(2) \qquad b = ng(n_1,\ldots,n_N)$$

where b is the index of total employment, n is the simple sum of persons at work and $n_1,\ldots,n_N$ denote total employment of the various n categories. The index of average quality per employed person is $g(n_1,\ldots,n_N)$ and this includes the effect of education.

The effect of average hours worked per person is obtained by dividing (1) by (2), yielding the average hours worked as h/n and average quality per hour worked as $e(h_1,\ldots,h_N)/g(n_1,\ldots,n_N)$. Education and other characteristics enter e and g. If these indices are unity throughout, then education has no effect on labour input. Let the underlying production function aggregating labour and non-labour inputs be

$$(3) \qquad y = y(a,x_1,\ldots,x_M,t)$$

where y is output, $x_1,\ldots,x_M$, denotes the services of non-labour inputs such as capital, intermediate fuels and raw materials and t is time, an index of the state of technology. Substituting (1)

in (3)

$$(4) \qquad y = y(he(h_1,\ldots,h_N),x_1,\ldots,x_M,t)$$

and normalizing by the total hours worked h

$$(5) \qquad y/h = y^{*}(e(h_1,\ldots,h_N),x_1/h,\ldots x_M/h,t)$$

where the left side variable y/h is output per hour or labour productivity. Note that y need not denote value added. It could represent gross output. Labour productivity is expressed as a function of labour quality e, intensity of usage of non-labour services x/h and an index of technology t. Through the contribution of education to labour quality change e the effect on labour productivity y/h can be determined. Since output is increasing in labour input, an increase in educational attainment, if e is not unity increases productivity growth defined as an increase in y/h. An alternative definition is to use total factor productivity, or the shift occurring in the production function because of time t. This is measured as a residual after the effects of the inputs. Hence the larger the educational effect in e, the smaller the growth of total factor productivity. Once the effect of education on e is determined, the effect on labour productivity growth can be determined directly.

5. Education and Labour Input

5.1 Specification

The objective is to measure the effect of education on labour input. In section 4, separate effects on hours worked per employed person and total employment are derived. In the utilized specification, labour input is classified by sex, age, education

and region for Canada 1971-1976. Let these characteristics respectively be denoted by levels S, A, E, and R.

Were employment solely to be classified by sex, there would be two categories of labour. The analogous index of labour input to (1) would be based on the two sexes, and there would be a quality index of labour, e_S. In the most complete classification examined, containing sex, age, education and region, there are six age categories, six education groups and five regions for each sex, or 360 categories altogether. These are indicated in Table 1.

The type of classification indicated in Table 1 permits the examination of the characteristics that determine the input provided by each worker. If there are regional differences in the contribution to labour input, these are reflected. Sex differences are also accounted for, but in the specialized case where all wage differences are attributable to productivity differentials. If there is a discriminatory component in wages, the productivity estimates require adjustment.

The analysis is performed for six aggregate education groups. Within each of these, there may be further disaggregation. However, the presence of short courses for those with given education on specific skills is less a concern, since these provide specific skills of use to individual employers, and the case for public policy intervention is less clear.

Age is an important factor in skill acquisition. Suppose younger workers provide below average input per hour, given education and skill levels. Upgrading may raise the average level provided per hour, at a low opportunity cost in lost output.

Table 1 Classification of Labour Input

Sex	Age (years)
1 Male	1 15-19
2 Female	2 20-29
	3 30-39
	4 40-49
	5 50-64
	6 65 or older

Region	Education
1 Atlantic (Newfoundland, Nova Scotia, New Brunswick, Prince Edward Island)	1 No schooling
2 Quebec	2 Some grade school
3 Ontario	3 Some high school
4 Prairies (Alberta, Saskatchewan, Manitoba)	4 Completed high school
5 British Columbia	5 Some university
	6 University degree completed and above

Note: There is some reclassification between education groups 4 through 7 in the 1976 Census, differing from the 1971 Census. Code numbers are as in the data base.

Consider a classification that includes education only. Then the labour input index would contain only six components, commencing from no education to university degree completed and above. There would be another quality index containing education only. For a specification of (1) as applied to the data used here, there are four first order effects for each of sex, age, region and education, and interaction effects between each of them. Hence the labour quality index in logarithmic form is

$$(6) \quad \ln e = \ln e_S + \ln e_A + \ln e_R + \ln e_E + \ln e_I$$

where the subscripts refer respectively to sex, age, region and education, and I refers to an interactive effect.

Regarding education, there is an additional issue relevant to post school training. The contribution of each level of education should be measured. Data comprise complete cross sections from the 1971 Census of Canada and the 1976 Census. They are individual records from the 1/100 sample in the two Census years. All records are examined first to determine whether the individual is employed, performing any work for pay or profit during the sample week. To be included, the worker must have information on all four employment characteristics. Data are available on compensation and earnings, hours worked per week paid and weeks paid per year from the 1971 Census, but analogous information is not available in 1976. The average annual hours worked for 1971 are also applied to 1976, and the relative wage structure of 1971 assumed to be constant. Total hours worked in 1971 are 1,200,552,500 and for 1976 1,546,640,000.

5.2 Education Contribution Per Person Employed

The contribution of education per person employed is indicated in Table 2. Total quality change per person employed declines by an annual average of 0.24 per cent. Education contributes positively, by increasing labour quality annually by one quarter of one per cent, but the remaining three effects are negative. The age and sex compositional shifts are 0.36 per cent each, although these are both upper bounds, neither being adjusted for discrimination. Regional shifts on balance are negative but negligible, contributing -0.03 per cent annually to labour quality change. By region, there is relatively little difference.

The relevant focus here is on the education effects. Here all categories save the post secondary sector make negligible contributions to change in labour quality. The four lowest groups, those with no schooling up to high school completed, have effects that are close to zero. The category of some university, including those who have attended a university institution and not community college graduates, has a contribution of 0.03 per cent. Fully 80 per cent of the entire contribution of education arises from those who are university graduates. The annual percentage growth is 0.2. Extensive research on labour quality has pointed to a large contribution of education. The results of Denison (1974, 1979) for the United States and Christensen, Cummings and Jorgenson (1980) and Walters (1968, 1970) for Canada confirm this. Investments in primary and secondary education yield little or no gain in increase in labour

Table 2. Persons Employed : Quality Sources, Canada 1971-1976
(annual average per cent)

Labour quality		-0.24
Region	-0.03	
Sex	-0.36	
Age	-0.36	
Education	0.25	
Total one way effects	-0.50	
Total interactive effects	0.26	
Individual sources		
Region		-0.03
Maritimes	-0.05	
Quebec	-0.02	
Ontario	0.10	
Prairies	-0.10	
British Columbia	0.04	
Sex		-0.36
Male	0.58	
Female	-0.94	
Age		-0.36
15-19	-0.58	
20-29	-0.29	
30-39	0.23	
40-49	0.18	
50-64	0.13	
65 and above	-0.03	
Education		0.25
No schooling	0.00	
Some grade school	0.01	
Some high school	0.01	
High school	0.00	
Some university	0.03	
University graduate	0.20	

quality. The opposite is true for investments yielding employment increases in those with post secondary education.

The remaining major factor associated with educational leave is age. By age, the two youngest groups contribute negatively to labour input. If training is being purchased at younger ages, the observed wage may be in excess of marginal product. The observed earnings profile is flatter than the marginal product profile. The use of wages as measurements of productivity leads to an upward bias in the case of younger workers.

On total employment, the results tend to reinforce the traditional educational investment view. The overall contribution of education to total employment growth is about one quarter of one per cent during the period 1971-1976, slightly lower than the estimates of Christensen, Cummings and Jorgenson (1980). Most of the contribution comes from the post secondary education sector. Regarding age, the contribution to labour input growth comes largely from the older sector of the work force. Hence the opportunity cost in terms of lost output is lower, the younger the trainee. While the full policy implications for educational leave are discussed later, the indication is that upgrading returns in productivity are highest for younger workers already with some education, receiving additional education. On a regional basis, there appears to be little difference in the contribution to labour input. Hence, any policies could be applied nationally without substantial requirement for regional variation. Table 3 examines the impact on the average hours worked per week.

Table 3. Average Hours Worked Annually : Labour Quality Sources, Canada 1971-1976

Labour quality			0.66
Region	-0.01		
Sex	0.15		
Age	0.29		
Education	0.34		
Total one way effects	0.77		
Total interactive effects	-0.11		
Individual sources			
Region		-0.01	
Maritimes	0.01		
Quebec	-0.04		
Ontario	-0.02		
Prairies	0.03		
British Columbia	0.01		
Sex		0.15	
Male	-0.28		
Female	0.43		
Age		0.29	
15-19	0.41		
20-29	0.10		
30-39	-0.10		
40-49	-0.07		
50-64	-0.07		
65 and above	0.02		
Education		0.34	
No schooling	0.00		
Some grade school	0.01		
Some high school	0.02		
High school	-0.01		
Some university	0.27		
University graduate	0.05		

5.3 Average Hours Worked Annually

The next empirical results are on the contribution of labour market factors on the quality of services provided per hour worked per person employed. Overall, the quality change here increases over the period 1971-1976 by 0.66 per cent, in contrast to a decrease of 0.24 per cent annually for the services per employed person. Education makes a contribution of 0.34 per cent annually to the increase in quality per average hour. Again, regarding region, there do not appear to be substantial differences across Canada. Among the sexes, conditional upon working, there is a greater contribution for females than males. Hence, there may be a large contribution to productivity growth from upgrading skills for women already at work.

Again, the principal characteristics of focus are age and education. For age, the largest gains occur in the youngest age groups. For those aged 15-19, there is an increase of 0.41 per cent, and most of the remaining entries are small or negative. In the education categories, the largest contribution comes from those with some university, at 0.27 per cent. While on a per hour basis the contributors to labour input growth are different from those on total employment by age, the situation is similar by education. The largest effects come from those with some university or more, with a total of 0.32 per cent out of the 0.34 per cent. There is almost no contribution at the elementary or secondary levels.

For policy on educational leave, the conclusion on the contribution of education per hour is similar to that for the effect on each worker employed. The effect is largest for those

with more education. For age groups, the opportunity cost is lowest for older workers, with those among the young increasing their contribution substantially. The largest effect is among teenage employees, who comprise a relatively small part of total employment. In 1971 there were 0.523 million 15-19 year olds employed in Canada, and 0.876 million employed in 1976. This represents 7.5 per cent of total employment in 1971, and 9.4 per cent in 1976. Other than among teenagers, there is no substantial variation in the contribution to productivity growth.

5.4 Total Hours Worked

Total hours worked are the product of total employment and average hours worked per person. The growth of total hours worked is then the sum of growth rates for total employment and average hours worked. In Table 4 is indicated the effect on total hours worked, the sum of effects in Tables 2 and 3. Total quality per hour increases by 0.42 per cent on average annually. At the aggregate level, only education contributes positively, with an effect of 0.59 per cent, while that for the remaining three factors is negative.

By region, the largest absolute magnitude is less than one tenth of one per cent per year. Ontario and British Columbia have positive effects, the remaining regions negative, but the differential across regions is not substantial.

For age, the two youngest categories remain those with negative contributions to labour input growth. For 15-19 year olds this is -0.17 per cent, while for 20-29 year olds it is

Table 4. Total Hours Worked : Labour Quality Sources, Canada 1971-1976

Labour quality		0.42
Region	-0.04	
Sex	-0.21	
Age	-0.07	
Education	0.59	
Total one way effects	0.27	
Total interactive effects	0.15	
Individual sources		
Region		-0.04
Maritimes	-0.04	
Quebec	-0.06	
Ontario	0.08	
Prairies	-0.07	
British Columbia	0.05	
Sex		-0.21
Male	0.30	
Female	-0.51	
Age		-0.07
15-19	-0.17	
20-29	-0.19	
30-39	0.13	
40-49	0.11	
50-64	0.06	
65 and above	-0.01	
Education		0.59
No schooling	0.00	
Some grade school	0.02	
Some high school	0.03	
High school	-0.01	
Some university	0.30	
University graduate	0.25	

-0.19 per cent. Among prime aged workers the effects are positive. THe lowest opportunity costs thus arise in younger workers, and this is before the capitalization required to determine the long run effect of increased training benefits.

The conclusion on education is the same. The benefits are substantial at the highest education groups, and almost zero for elementary or secondary schooing. Section 2 focuses on the benefits of educational leave, and the costs must also be accounted for in the development of policy. However, with contributions of 0.02 per cent to labour input growth from the elementary school category, unless the costs are negligible, there is little net benefit from training in this area. The contribution from the post secondary sector is the most substantial, being 0.30 per cent for those with some university and 0.25 per cent for those with a university degree.

5.5 Productivity Growth

The measured effects are for the contribution of each factor to labour input growth. It remains to examine the effects on productivity growth. The overall production function for labour productivity, or output per hour worked, depends on labour quality. Taking the logarithmic derivative of (6) in time, the growth of labour productivity is the sum of the growth of labour quality multiplied by the share of labour, the growth of services of non-labour inputs per hour multiplied by their shares and the growth of total factor productivity, or the shift in the production function.

For productivity, the results depend on whether value added or gross output is used as the measure of total output. If value added is used, and the average share of labour compensation is 0.66, then each entry in Table 4 is multiplied by this number to yied the contribution to the growth in labour productivity, the commonly used series published by Statistics Canada. All results and conclusions obtain, but the results are all scaled by this factor. Since the contribution of education to total labour input growth is 0.59 per cent annually, the effect of education on labour productivity growth is 0.40 per cent. If gross output is used, the share of labour would be lower, because intermediate inputs also receive compensation.

The contribution of each level of schooling is also scaled by this factor. For example, the effect of some university on productivity growth is to increase it by 0.23 per cent. It remains the case that higher education effects would increase labour productivity, and those with less education would have almost no effect. The two high school categories, totalling 0.02 per cent in contribution to labour input, have an effect of 0.013 per cent, or about 1/100 of one per cent, on increasing labour productivity, using value added as output. With gross output as the definition, the effect would be lower.

Regarding total factor productivity, this is measured as a residual, after the contributions of each factor. Hence, there is no contribution of these components to total factor productivity growth directly. However, measured growth is in error if the various components are excluded. The higher the effect of a given source, the lower is the growth of total factor productivity.

Hence, it is prime aged workers and the relatively educated who make the largest contributions to labour productivity growth. There is also a substantial difference between men and women, though part of this may be attributable to discrimination. Regional differences do not appear substantial.

6. Implications for Educational Leave Policy

The focus of this study remains on the benefit side of educational leave. In terms of productivity gains, it appears that there is little gain in basic skill upgrading for adults, at least from the point of view of productivity. Hence, the focus is on policies for adult retraining that include post secondary training, particularly for younger workers.

The results explain the observed phenomenon in Western Europe for the participants in educational leave to be primarily younger workers. On the cost side, the alternative wages are lower, and the period of return is larger. These results make that conclusion hold a fortiori, for they obtain even without these cost calculations. If a young worker is absent from the job, there is relatively little loss in productivity, while this increases for an older worker. At the same time, the educational effects are dominant at later stages, so it appears that the largest gains accrue to retraining young workers, either teenagers or those in the 20-29 age group, but aleady being secondary school graduates.

On a regional basis, this policy appears robust. For men and women, there are conceptual problems in productivity measurement.

If productivity differences are measured by observed wages, then the results obtained here are applicable. If part of wage differences is discrimination, then the conclusions are less clear, but the qualitative implications are the same. Men make a higher contribution for each employed. However, for those already employed, there is a larger gain per hour for women. Since educational leave policies focus on those already employed, the results of Table 3 suggest there may be a particular gain among women, but this does depend on how productivity is measured.

The results may overstate the case in favour of post secondary training, because the 1971 earnings relatives were used, and there is evidence that the relative increase in wages for this group during the 1980's was below the average for all workers. However, the small contribution of the less educated to productivity growth remains, and the gap between the educational sectors in terms of contribution is sufficiently large that it would take a substantial shift in wages to create benefit gains in favour of retraining at the basic skills level.

Further, suppose the relative wage of younger workers has decreased during the 1970's and early 1980's. This implies a larger negative effect of younger workers on productivity, especially combined with continuing increases in relative share of total employment. In turn, this increases the gain in productivity associated with the training of younger workers. It is not sufficient to examine the productivity contribution of education when analyzing paid or unpaid educational leave. The age structure, and relative wages by age, are also relevant.

7. Other Issues in Education, Leave and Productivity

There are other issues and factors to be taken into account in a comprehensive policy of educational leave. First, while this study concentrates on productivity, this is defined only in a market time context. Education may enhance the time used in home production and in leisure activities. The appropriate wage used to price these activities is the shadow price of time to the household, the producer in this case. For marketed time, the relevant price is the gross wage before personal income tax, as used in this study.

The price of non-market time has conceptual problems. For those not working any hours, it may exceed the after tax wage, if the choice not to work is made voluntarily. If the choice is not made voluntarily, and the person is involuntarily unemployed, then the price is less than the after tax wage.

Since wages increase with education, imputations for the enhanced use of non-market time tend to strenghten the conclusions in favour of education. However, education may not increase productivity in non-market time at the same rate as market time.[11]

Second, the effects of education on productivity are total rather than marginal effects. A person with some secondary training is contributing all his or her educational resources. In practice, educational leave would be fostering an increment from one educational level to another. The marginal return to additional education requires the calculation of opportunity costs of that level. If the alternative wage of a university

graduate in the market is high, it may be less clear that additional time off to acquire further skills is required. This implies that the costs of the education should be included. Nevertheless, the conclusion remains that unless the cost of training an already less educated worker is extremely low, there is little gain in social return from providing additional training.

Third, the policies do not include imputation for the social benefits of education. Education may contribute more than either market or non-market productivity. The benefits of a more literate, numerate and articulate work force may justify these investments being concentrated at the lower levels. However, the policies will have to rely on these social benefits, for the productivity benefits are small in comparison with alternatives.

8. Conclusion and Implementation

In conclusion, educational benefits at the workplace appear to be concentrated on those with relatively high levels of education. Also, the younger the worker, the greater the current increase in output per hour. Hence, the returns are greatest for younger workers already with high school education.

If leaves are paid, the tendency is for employers to demand specific education. The three empirical predictions, upgrading at higher levels, high participation rates among young workers and specific skill upgrading, characterize educational leave programs in Western European countries.

General skill training and basic literacy can be generated with paid leave provided with public compensation. However, the

political weight attached to this must be strong enough to counteract the relatively high cost in lost output and low subsequent gain in productivity among the trainees.

Footnotes

1. The evidence for Canada also suggests that the return to schooling also declines with the level of education.

2. Organization for Economic Co-operation and Development(OECD), Alternation Between Work and Education, Paris, OECD, 1978, p.56.

3. K. von Moltke and N. Schneevoigt (1977), examine information of this nature from several Western European nations.

4. Details of the Swedish plan are contained in von Moltke and Schneevoigt (1977), Chapter 6.

5. See Labour Canada,Report of the Commission of Inquiry on Educational Leave and Productivity, Ottawa, June 1979.

6. Berndt and Christensen (1974) obtain such high elasticities for U.S. manufacturing 1929-1968.

7. Walters (1968), Table 30, p. 51. Using the earnings relatives of the United States permits the comparison of international productivity. The complete sources of growth form is in Walters (1970).

8. Walters (1968), Table 40, p. 65.

9. Christensen, Cummings and Jorgenson (1980), Table II.A, 3C, no pagination.

10. See Chinloy (1980,1981,1982).

11. Jorgenson and Pachon (1983) perform imputations for the price of time outside the market, by education. They use the observed wage after tax. The results indicate a larger contribution than if only market time is used.

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